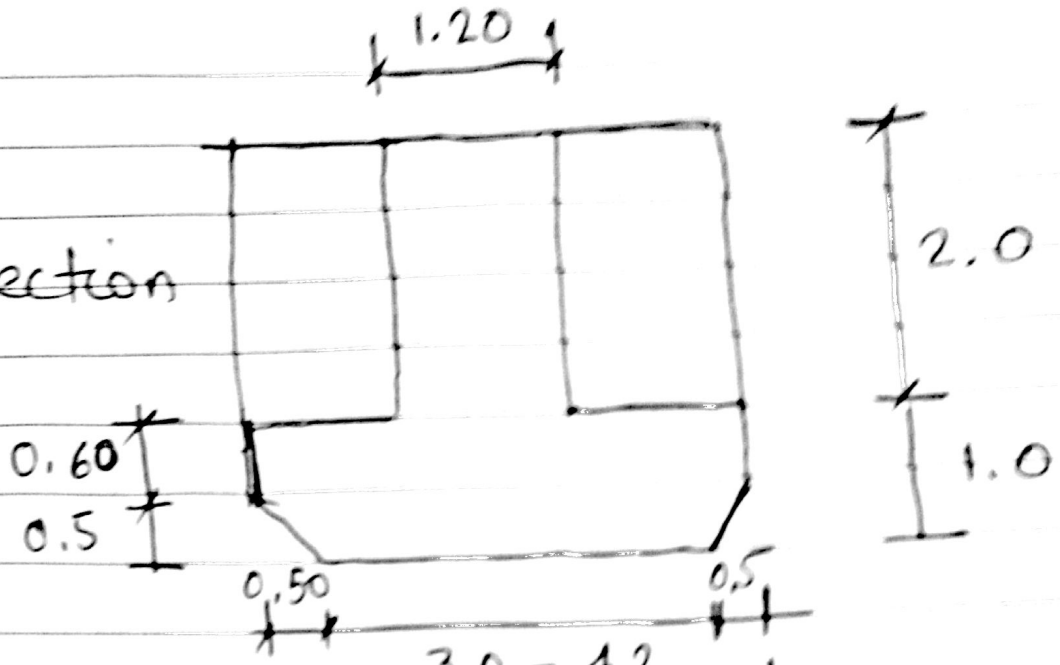
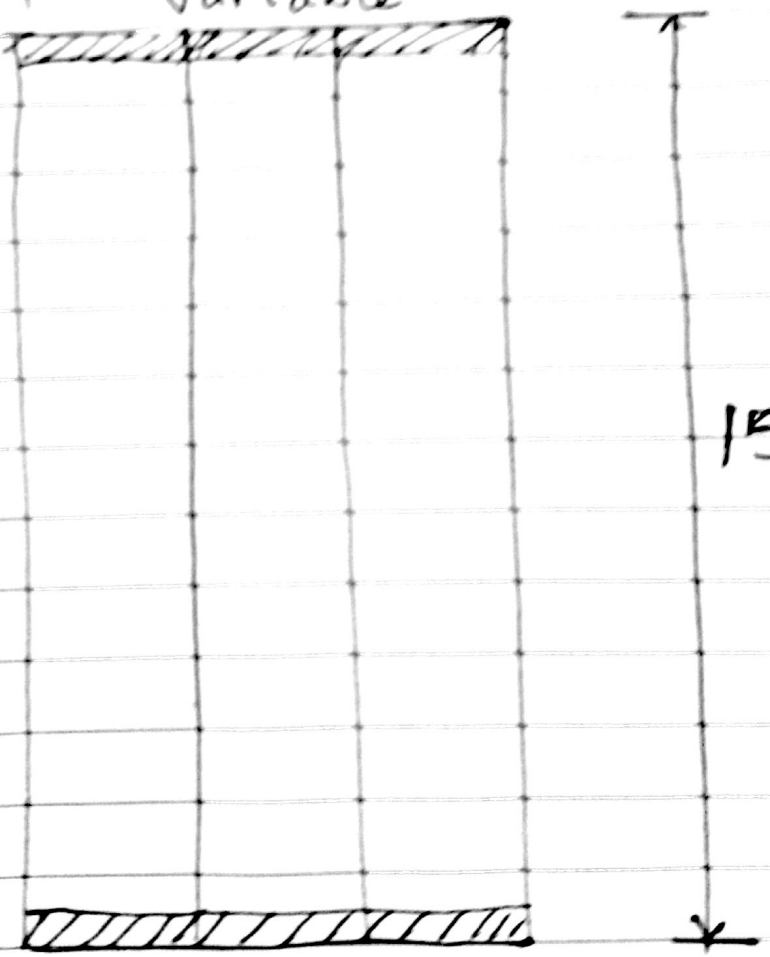
cross section



plan



The Cap beam will be casted in two stages

Stage 1 : The lower flange

Stage 2 : The upstand web

* The formwork calculations are done according to the working stress method.

** Stresses in concrete supporting system i.e in timber and steel as well as the plywood are taken from "Formwork for Concrete" and the "Jordanian Code for formwork".

Design of Different components of the formwork and scaffolding system :

The Plywood sheathing (decking)

Spacing of supports : 200 mm

Load on Plywood due to fresh concrete w_c

$w_c = 1.1 \times 25 = 27.5 \ kN/m^2$

$L.L = 3.0 = 3.0 \ kN/m^2$

total load $= 30.5 \ kN/m^2$

$$M = \frac{0.2^2 \times 30.5}{10} = 0.12 \ kN\,m/m$$

$$f_b = \frac{0.12 \times 10^6}{22150} = 5.4 \ N/mm^2$$

$< 11. \ N/mm^2$ OK.

$f_b = \frac{M}{(KS)}$

KS = Modulus of effective section

$= 22150 \ mm^3$

$$V = \frac{0.2 \times 30.5}{2} = 3.05 \ kN$$

$$v = \frac{3.05 \times 10^3}{14\,312} = 0.213 \ N/mm^2$$

$< 0.4 \ N/mm^2$

O.K.

$v = \frac{V}{(Ib/Q)}$

(Ib/Q) = shear constant

$Ib/Q = 14312 \ mm^2$ for plywood 18 mm

The Joist (timber planks 50X100)

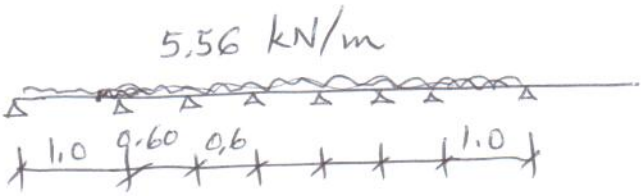
s = Spacing of joists 200 mm

L = Spacing of supports 600 mm (c/c)

$$\omega = 0.2(1.1 \times 25 + 3.0) = 5.56 \text{ kN/m}'$$

$$M_{(\pm ve)} = \pm \frac{5.56 \times 0.6^2}{12}$$

$$= \pm 0.17 \text{ kNm}$$

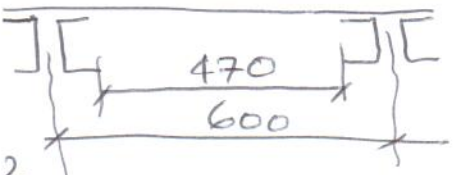


$$f = \frac{M}{Z} = \frac{0.17 \times 10^6}{\left(\frac{50 \times 100^2}{6}\right)} = 2.04 \text{ N/mm}^2$$

$< 7.2 \text{ N/mm}^2$ (allowable)

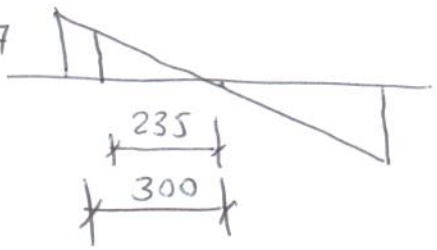
$$V = \frac{5.56 \times 0.6}{2} = 1.67 \text{ kN}$$

$$V_{eff} = \frac{0.235}{0.30} \times 1.67 = 1.30 \text{ kN}$$

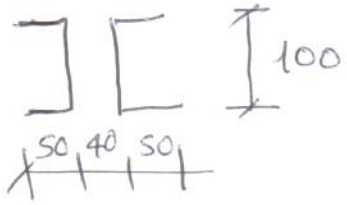


$$v = \frac{1.3 \times 10^3}{50 \times 100} \times 1.5 = 0.39 \text{ N/mm}^2$$

$< 0.6 \text{ N/mm}^2$ allowable



Stringers (2 UPE 100)



S = Spacing of stringers = 0.6 m

L = Distance between vertical supports = 1.0 m

$$\omega = 0.6 \times (1.1 \times 25 + 3.0) = 18.3 \text{ kN/m}$$

$$M = \frac{18.3 \times 1.0^2}{12} = 1.53 \text{ kNm}$$

$$f = \frac{M}{Z} = \frac{1.53 \times 10^6}{2(38.2 \times 10^3)} = 20 \text{ N/mm}^2$$

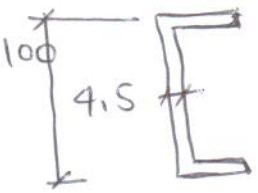
$< 148 \text{ N/mm}^2$

O.K.

$$V = \frac{18.3 \times 1.0}{2} = 9.15 \text{ kN}$$

$$v = \frac{9.15 \times 10^3}{2 \times 100 \times 4.5}$$

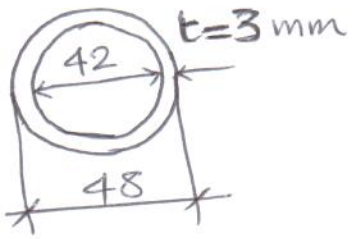
$= 10.2 \text{ N/mm}^2$



Safe $< 98 \text{ N/mm}^2$

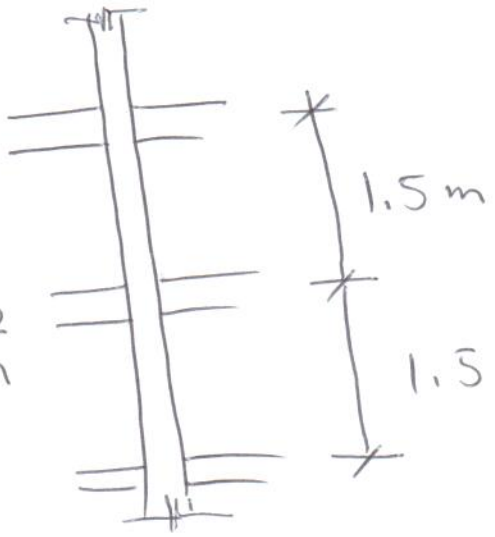
Vertical Supports (Cuplock Standard)

Max. spacing of horizontal bracing = 1.50 m



∴ Unsupported length

= 1500 mm



Properties of section:

$$A = \frac{(48^2 - 42^2)\pi}{4} = 424 \text{ mm}^2$$

$$I = \frac{(48^4 - 42^4)\pi}{64} =$$

$$= 107831 \text{ mm}^4$$

$$r = \sqrt{\frac{107831}{424}} = 16 \text{ mm}$$

r = radius of gyration $= \sqrt{\frac{I}{A}}$

λ = buckling ratio

$$= \frac{l_u}{r} = \frac{1500}{16} = 94 < C_c$$

$$C_c = \sqrt{\frac{2\pi^2 E}{f_y}} = \sqrt{\frac{2\pi^2 \times 2 \times 10^5}{250}} = 126$$

Calculation of the bearing capacity of the vertical supports

$\lambda < C_c$

The allowable design compressive stress is calculated according to the following equation :

$$f_c = \frac{\left[1 - \frac{\lambda^2}{2C_c^2}\right] f_y}{F.O.S}$$

where $F.O.S = \frac{5}{3} + \frac{3\lambda}{8C_c} + \frac{\lambda^3}{8C_c^3}$

$$F.O.S. = \frac{5}{3} + \frac{3 \times 94}{8 \times 126} + \frac{94^3}{8C_c^3}$$

$$= 2.0$$

$$\therefore \quad f_c = \frac{\left[1 - \frac{94^2}{2 \times 126^2}\right] \times 250}{2.0}$$

$$= 90.2 \quad N/mm^2$$

The allowable load F_c :

$$F_c = f_c \, A$$

$$= \frac{90.2 \times 424}{1000} = 38.2 \quad kN$$

Calculation of actual load on support :

$$\text{Total load of Cap/m}^2 = \frac{(4.2 \times 1.1 - 0.5 \times 0.5 + 2.0 \times 1.2) \times 25}{4.2}$$

Total Load $= 40.3 \text{ kN/m}^2$

add L.L $= \underline{3.0} \text{ kN/m}^2$

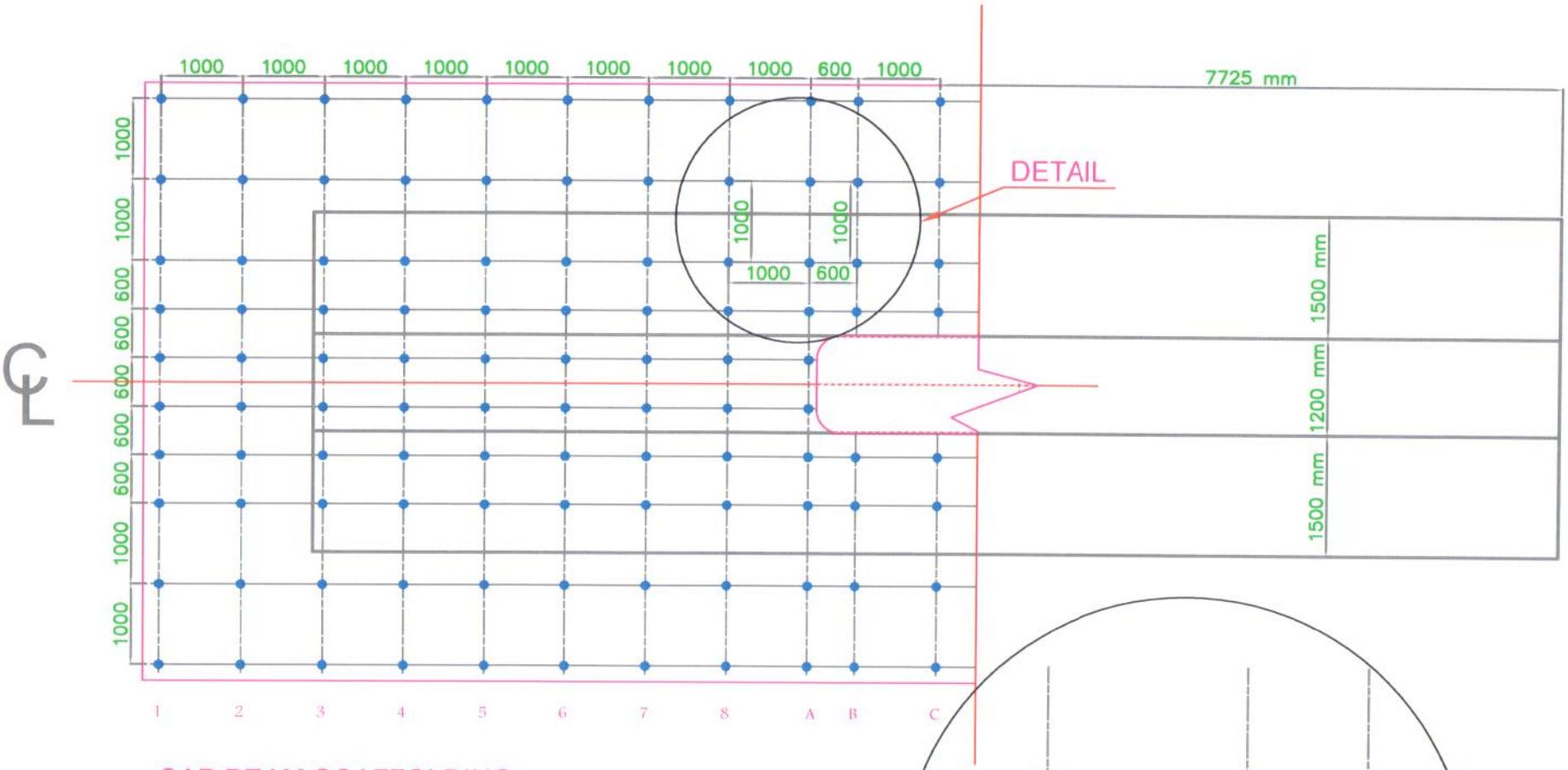
43.3 kN/m^2

Actual load per support : F_{act}

$F_{act} = 43.3 \times 1.0 \times 0.6$

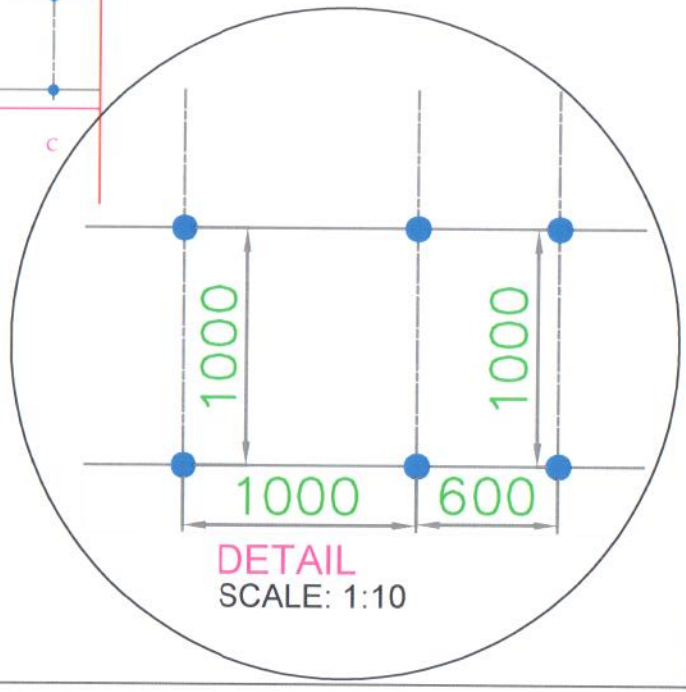
$= 26.0 \text{ kN} < F_c = 38.2 \text{ kN}$

$\therefore$ O.K.



CAP BEAM SCAFFOLDING AGREEMENTS

SCALE: 1:25



DETAIL

SCALE: 1:10

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أمانة العاصمة المقدسة
وكالة التعمير والمشاريع
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PROJECT:
عملية تنفيذ قاطع طريق الطائف السيل
مع شارع جبل النور ضمن مشروع
تطوير محور شرق - غرب مكة

DRAWING TITLE:
CAP BEAM SCAFFOLDING

DRAWING No.	DATE	SCALE	SHT NO
1	MAY 24, 2014	AS SHOWN	1 of 1
DRAWN BY: HAWB	DESIGNED BY	CHECKED BY: AAQ	APPROVED